The Role of Policy in Shielding, Nurturing and Enabling Offshore Wind in The Netherlands (1973-2013)

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Abstract:

It is widely acknowledged that many renewable energy technologies cannot (yet) compete with incumbent (fossil fuel) options e.g. in terms of price. Transitions literature argues that sustainable innovations can nevertheless break out of their 'niches' if properly shielded, nurtured and empowered. Most studies using this perspective have focused on how innovation champions engage in shielding, nurturing and empowering (SNE) activities: none have so far focused specifically on the role that policy plays in relation to these three processes. This paper therefore aims to analyze the way in which policy constrains and enables the shielding, nurturing and empowering of renewable energy innovations. To do so, it presents a qualitative case study of the development of offshore wind power (OWP) in The Netherlands over the past four decades. Based on interpretation of a wide variety of written sources (academic histories, reports, policy documents, parliamentary debate transcripts, news media) and nine semi-structured interviews, it discerns six periods of relative stability in the history of Dutch offshore wind. It then analyzes the effects of various policies on the shielding, nurturing and empowering of offshore wind in these periods. The paper contributes to transitions literature (1) by providing an analysis of how policies can enable and constrain the shielding, nurturing and empowering of renewable energy

innovations, and (2) by bringing together, for the first time, fragmented accounts of the surprisingly long history of Dutch offshore wind development and implementation. Both contributions are timely, given the recent reprioritization of OWP on the Dutch policy agenda.

1. Introduction

Over the past decade, offshore wind has proven to be a growth market. Having been considered a promising near-future energy source since the early 2000s [1] [2], global installed capacity has increased from under 100 MW in 2001 to well over 6,500 MW by early 2014. A further 3,000 MW is currently under construction and an additional 22,000 MW is consented [3]. Despite this significant growth, the majority of which has been realised in the UK [4], offshore turbines account for less than 2% of global wind power capacity [5] and its contribution to global electricity production remains marginal at around .04% [6]. Offshore wind has to compete with efficient, matured and cheaper incumbents solutions [7], and is not simply a diversification of onshore wind to a new segment [8]. It is relatively expensive compared even to other renewable energy sources, in part because of technological challenges like harsh and extreme installation and operation conditions and connection to electricity grids [9]. As such, the recent capacity growth has been facilitated by public support in the form of subsidies, tax breaks and other incentives.

This was the case in The Netherlands as well, where two subsidised OWP farms were connected to the grid in 2007 and 2008, which made The Netherlands the third largest offshore wind country after 'first mover' Denmark and 'early adopter' The UK. The Netherlands appear to be in an ideal position to take advantage of this particular growth market, having a widely-known history of harnessing the power of wind; an international reputation for civil engineering in aquatic environments; substantial wind resources in a favourable part of the North Sea; an excellent infrastructure of sea ports experienced in facilitating offshore industries and providing access to Dutch exclusive economic zone; and ambitious climate change and sustainable energy goals (interviewees 3,4,7,9). The Netherlands also undertake pioneering research into offshore wind, and have several large firms that are highly active in the offshore sector internationally and have amassed experience especially in the development and construction segments of the offshore wind energy value chain (interviewees 1,2,6). Nevertheless, no further deployment has taken place since 2008 and The Netherlands was outpaced by both Belgium and Germany in 2012 (see: figure 1).

[INSERT FIGURE 1 ABOUT HERE]

Figure 1 clearly shows that since 2008, several countries in the North Sea Region have expanded their installed capacity, whereas this development has stagnated in The Netherlands. In their quantitative review of the European offshore wind energy innovation system, Wieczorek *et al.* [7] also find that Dutch offshore wind market formation is lacking compared to other nations, in spite of a strong knowledge base and world-renowned offshore contractors: "(…) Dutch constructors do belong to the group of international market leaders but, contrary to the German firms, they are not backed by the national government and a strong home market." [7: 302]. Indeed, they point to a particular weakness in the Dutch offshore wind innovation system compared to that in other North Sea Region nations in terms of the current level of 'guidance' offered by formal and informal institutions (e.g. governmental commitment, presence and reliability of policy goals and vision, expressed expectations, presence and quality of regulatory regimes, policy instruments and licensing procedures) [7: 301]. And indeed: while initially thought of in policy circles as promising, policy support for the relatively expensive offshore wind option was withdrawn from the Dutch renewable energy subsidy schemes in favour of cheaper options (interviewees 3,4,6).

We agree with Wieczorek *et al.* that the fate of Dutch offshore wind seems to be tied strongly to the direction in which the policy winds are blowing. Recently, the government's attitudes regarding offshore wind appear to have changed once again: in late 2012, the Dutch government increased its target for renewable energy generation in 2020 from 14% to 16% in 2023 [11] and acknowledged that this target can likely not be realized without a significant increase in the application of offshore wind energy [12]. Although the renewable energy target has decreased again since, the government's ambition is currently to have 4,450 MW installed by 2023. This reprioritization of offshore wind on the Dutch policy agenda leads us to this paper's main research question: *how did policy enable and constrain the development of offshore wind in The Netherlands?* No comprehensive review of Dutch offshore wind policy currently exists in literature: most policy reviews have so far focused mainly on the technology's *onshore* application (e.g. [13],[14],[15],[16],[17]): offshore wind developments are either cursively discussed or omitted, e.g. on the argument that they "(…) are a different story altogether since wind energy offshore has met with very different challenges in its development and implementation" [15: p.18]. This paper therefore also aims to make a second contribution: providing a comprehensive, longitudinal review of Dutch offshore wind policy throughout the (perhaps surprisingly long) history of the technology's development and implementation – an account so far lacking in literature.

2. Conceptual framework

Van de Ven distinguishes between two basic scientific models: variance models and a process models [18]. Variance models typically aim to establish statistically significant relations between dependent and independent variables, and explanations tend to take the shape of causal models that incorporate these variables (i.e. "X causes Y") [18]. Conversely, process models aim to give meaning to a specific sequence of events: they contextualize significant relations (i.e. “explain how it came to be that X causes Y”). This paper is underpinned by a process model. This does not mean that it is our goal to only *describe* the Dutch offshore wind policy history: “(...) to describe a process, one needs event sequences. But to *explain* a process one needs to identify the generative structures that enable and constrain it [19: p.722]. To find such ‘generative structures, we turn to transitions literature. In this field, a conceptual framework has been developed to analyse the development of ‘infant’ sustainable innovations such as offshore wind. These innovations, which present sustainable alternatives to mainstream electricity generation options but are not (yet) technologically and/or economically competitive, are conceptualized as ‘niches’. Early work on niches primarily emphasized how innovations within these niches ought to be *nurtured*, focussing specifically on the articulation of expectations, the formation of networks, and the organization of learning processes [20],[21],[22]. More recently, the emphasis has broadened from what goes on *within* these protected spaces to (1) how these spaces are constituted, and (2) how they are removed or institutionalized. The former process is referred to as *shielding* (i.e. strategic work aimed at creating protected space by exempting an innovation from some mainstream selection environment), whereas the latter is referred to as *empowering* (i.e. strategic work aimed at the wider up-scaling of a niche). Several studies have confirmed the utility of analysing these three processes for understanding niche developments (e.g. [9],[23],[24],[25],[26]).

Our paper uses this ‘shielding, nurturing, empowering’ framework as a basis for its ‘analytical chronology’ [27] of how policy enabled and constrained the shielding, nurturing and empowering of offshore wind in The Netherlands. But although earlier studies stress the importance of policy in “constituting, supporting and disrupting” [23] protected spaces, none have specifically focused on the role of policy in these processes. We therefor propose the following adaptations to the framework (see: table 1):

1. We propose that policy can enable, intentionally or not, the shielding of a sustainable innovation by enabling the emergence of a dedicated research community around a sustainable innovation (e.g. through basic research funding or targeted programs) or the

realization of experiments, pilot projects, and demonstration projects (e.g. financial support, rule exemptions).

2. We propose that policy can enable nurturing by contributing to e.g. the organization of learning processes within a niche, the formation of deep and heterogeneous networks, or the emergence of shared and specific expectations. And thirdly, policy can empower a sustainable innovation when it is either aimed at rendering such an innovation competitive under conventional criteria and has an explicitly temporary character ('fit-and-conform') or when it enables the institutionalization of sustainable values and/or beneficial institutional or infrastructural reforms ('stretch-and-transform').
3. We propose that policy can constrain these developments by providing *dis*incentives on these dimensions, or by withdrawing previous incentives.

[INSERT TABLE 1 ABOUT HERE]

The paper will test these propositions using a qualitative case study whose methodology is described in the following section.

3. Methods and data

We first compiled a timeline of key events around Dutch offshore wind power developments through desk research drawing on heterogeneous sources such as existing academic papers, histories of renewable energy sources, grey literature, trade press, stakeholder- and government reports, policy documents, parliamentary debate transcripts, and news articles. To confirm and complement the events on the resulting timeline, we subsequently did nine expert interviews [28]. The experts were strategically chosen for their knowledge of specific aspects of Dutch offshore wind developments, e.g. the energy sector, the offshore construction sector, policy developments, scientific research etc. (see: Table 1). We used a semi-structured interview method, which enabled us to tailor the interviews to the interviewees and explore new themes emerging from their responses [29]. The interview guide's topics were: relevant actors, events, projects and policies.

[INSERT TABLE 2 ABOUT HERE]

Using the interview results, we transformed the aforementioned timeline into a more elaborate case history, in which we discerned six periods that are characterized by a degree of stability

regarding some aspect of offshore wind energy development, e.g. in terms of the relevant policy regime, the actors involved, and/or the content of the debates around the technology. We then interpreted how the various policies (and the research programs, subsidy schemes, rules and regulations etc. than they resulted in) contributing to shielding, nurturing and empowering, by using the indicators listed in table 1. This periodization appears in section 4, along with tables containing aforementioned interpretation of policy effects on shielding, nurturing, empowering of offshore wind in the various periods. All translations are ours. Section 5 concludes and discusses.

4. Dutch offshore wind policy history

4.1 Early OWP research (1973 – 1985)

The first Dutch study of the potential of OWP was made in 1973 by the Industrial Oceanography Council. The IRO had been established to promote the interests of the Dutch offshore industry in 1971, some 10 years after drilling for gas on the North Sea had begun as a result of the discovery of large reserves of natural gas on Dutch soil in the late 1950s. The 1973 oil crisis raised awareness of the risks of dependence on foreign fossil fuels, which gave a boost to the offshore fossil fuel efforts that the IRO was primarily concerned with. It also triggered much discussion about alternatives to fossil fuels [13]. Although the government's primary focus was on energy saving and nuclear power, renewable sources were discussed also, and one of these was wind energy. The IRO felt that wind energy at sea might possibly constitute an interesting future direction for Dutch offshore industry and, as it was its mission to explore such opportunities, it made a study of the economic and technical feasibility of what it referred to as "aero-generators at sea" in late 1973. A "Working Group Wind Energy" was established with representatives from the Netherlands Organisation for Applied Scientific Research TNO aircraft manufacturer Fokker, the electricity sector's research institute KEMA, engineering agency Marcon, machine manufacturer VMF. It produced a report entitled *Wind energy plants in the North Sea* that concluded that offshore wind could contribute significantly to Dutch energy supply through the production of electricity and/or hydrogen [30]. It strongly advised more research into offshore wind energy, but stated that the construction of grid-connected offshore wind energy plants some 15 km. offshore was already technologically feasible. Its higher costs (compared to fossil fuel or nuclear power) were argued to be offset by the creation of new jobs and its potential as an export product. The report argued that the first offshore wind energy plant could be constructed by the mid-1980s: it envisioned the construction of fifty to a hundred 10 MW turbines, of a triple-nacelle design similar to that suggested in 1972 in the USA [31] which would need to be interspaced by about 1 km [32]. Because of the large area required, "the

North Sea emerges as the only realistic location for the large-scale application of wind energy plants." Additional advantages of offshore placement were argued to be the lack of "visual hindrance or disruption of radio- and television reception" [30], which had been one of the problematic features of the 1960s experiments in retrofitting traditional windmills with electricity generators [13]. The engineering community took the idea seriously. For example, at a symposium held at Eindhoven Polytechnic (THE), TNO vice-chairman Boon referred to large-scale offshore wind energy a "very real" option which, using "no more than half of the Dutch sea surface", could generate the total Dutch energy demand many times over [33]. In July 1974, the IRO report was presented to the Ministries of Economic Affairs and Science Policy in July of 1974 [34] and also made its way to the National Steering Group Energy Research (LSEO) [35]. The LSEO had been established earlier that year to evaluate options for the diversification of the Dutch energy supply and set up research programs based on these evaluations, and TNO vice-chairmain Boon was one of its members. The LSEO's 1975 interim report contained suggestions for research programs around various alternative energy sources, one being wind energy. In addition to arguing for an assessment of turbine designs, meteorological research, and a study of electricity transport issues in general, it also specifically called for an evaluation of the possibilities for offshore wind energy. The report proposed the construction of "(…) smaller production units (e.g. several dozen) using turbines on as of yet unspecified locations on the main land, as well as medium projects (Markerwaard, Waddenzee, Oosterschelde, IIsselmeer) and large projects (North Sea)" [36]. The proposed offshore siting of 'medium' and 'large' projects makes sense given the envisioned scale: if production units involving 'several dozen' turbines were defined as *small*, then - much like the 1974 IRO report had suggested - the inferred size of a *large* project effectively necessitated going offshore in a country as small and densely populated as the Netherlands. Upon the presentation of the report, a working group, whose members included the original IRO report's main author, was tasked with transforming the LSEO report's recommendations on wind energy in general into a coordinated national research program. Their advice, which included an assessment of offshore wind, was adopted by the LSEO, on whose advice the Ministry of Economic Affairs subsequently initiated the first National Research Program Wind Energy (NOW-1) in 1976. And so, while the rapid growth of North Sea oil- and gas exploitation shifted IRO's focus away from offshore wind energy and towards these lucrative offshore activities in the second half of the 1970s [37], the advice contained in their wind report - a national research and development program - had been followed up.

Nevertheless, offshore wind was only a very small part of the NOW-1 program, whose general aim was to determine whether wind energy could significantly contribute to Dutch energy supply [13, p.142]: only some 2% of the program's 19 million guilders (~22 million 2013€)

budget went to offshore wind, compared to 80% of the budget for research into horizontal and vertical axis turbines, 6% for grid connection issues, and 5% for meteorological characterization [38]. The NOW-1 final report [39] was cautiously optimistic about wind energy in general, but less so about offshore wind: in spite of acknowledging offshore advantages in terms of availability of locations, lack of "horizon pollution" and noise nuisance and "minimal environmental risks", the report deemed its costs, which it estimated at double those of realizing the same capacity on land, prohibitive. It argued that "(…) locating wind turbines at sea would deserve attention primarily if large-scale application on land should turn out to be impossible in terms of spatial planning policy" [39: p. 30]. NOW-1 was followed up by NOW-2 (1981-1984) whose 'O' now stood for 'ontwikkeling' (development) instead of 'onderzoek' (research), signifying a shift from exploratory research to research aimed at concrete implementation [13: p.154-155]. Again, offshore wind was not the main focus: it was placed in the 'miscellaneous' category and again received some 2% of the now 37 million guilders (~32 million €2013) budget. The offshore budget was used to make a contribution to the offshore component of the International Energy Agency (EIA)'s *R&D Wind Energy Conversion Systems* (WECS) program [38],[40]. This international program's aims were to evaluate the economic feasibility of offshore wind and develop a plan for the joint design, construction and operation of a prototype. The Netherlands, through contracting partner the Dutch Energy Research Centre (ECN), was responsible for the conceptual design of an offshore wind energy conversion system [41], which by 1984 resulted in a plan for a 1 GW offshore wind energy plant [38]. Unsurprisingly, the project's final report concluded that the costs of offshore wind energy were "somewhat above the present range of economic interest" but interestingly also stated that "[p]ublic reaction may force earlier consideration of offshore wind energy, particularly in Denmark and The Netherlands, both densely populated countries" [42].

[INSERT TABLE 3 ABOUT HERE]

4.2 An offshore solution for an onshore problem (1986 – 1999)

Over the 1980s, expectations about *onshore* wind had increased. The 1984 final report of a Broad Societal Discussion on Energy Policy (which had been prompted by a policy stalemate regarding expansion of the nuclear power program) had concluded that a goal of 2,500 MW onshore by the year 2000 was "ambitious but possible" [43: p.300]. In its 1985 response to the report, the government mitigated this expectation somewhat by stating that before 2000, a wind energy contribution in excess of 1,000 MW was not to be expected [13: p.153]. But in the

second half of the 1980s, nuclear power gradually disappeared from the policy agenda following the Chernobyl disaster, and the idea of 'sustainable development' received a significant boost following the publication of the Brundtland-report *Our Common Future.* Discussions around this report led to the first *National Environment Policy Plan NMP* of 1989 aimed at preserving the carrying capacity of the environment to enable sustainable development [13].

When NOW-2 was succeeded by an Integral Wind Energy Program (IPW) the idea of '1,000 MW in the year 2000' had evolved into a policy goal [13: p.150-154]. To policymakers, the goal seemed within reach: popular opinion about wind power was favourable, so they expected ample sites to become available without problems [44]. However, local resistance to wind farms, often framed in terms of visual hindrance and bird mortality, was far greater than expected. By the mid-1990s, only some 200 MW had been realized. At the time, policymakers attributed this to the so-called 'not in my backyard syndrome' (NIMBY), meaning the phenomenon that people are generally in favour of wind power unless it's being implemented in their direct environment [44]. In reality, this attribution does not do justice to the motives of most opponents and downplays suboptimal policy choices that contributed to stagnating implementation, such as "aloofness" in the process of obtaining the requires sites [44], favouring large projects proposed by the energy sector over smaller decentralized ones, and a subsidy structure that focussed on installed capacity rather than electricity produced [13],[44].

Nevertheless, policymakers believed 'NIMBY' was the main issue [33] and increasingly saw the siting of wind farms offshore as a possible way to circumvent it (interviewee 3). When IPW was succeeded by the Wind Energy Application Program (TWIN 1992-1995) [14: p.97], it specifically articulated a goal of 200 MW *offshore* capacity by 2010 [45: p.77]. The Noord-Holland Province Electricity Company (PEN) was the first to make use of subsidies for offshore wind projects [46]. Expecting that offshore locations would have fewer objectors but also realizing that they would pose new challenges in terms of installation and maintenance as well as a higher costs [47], PEN wanted to gain knowledge and expertise early on. There was however no long-term strategy: "PEN didn't have a clear-cut idea about how to proceed afterwards. The attitude was one of 'let's just do this, and we'll see what we run into. Because it would be too complicated out at sea, they chose the IJsselmeer" (interviewee 3). This ~1100 km^2 artificial lake had been created in 1932 by the closing of the Zuiderzee bay. The 2 MW *Lely* project, some 0.8 km from the shore in 5-10 meters of water whose location was determined by military and heritage coast exclusion zones as well proximity to a harbour (interviewee 3), was constructed between 1992 and 1994 and became the world's second offshore, grid-connected wind farm. Half of the parks costs were covered by TWIN and the IEA's Centre for the Analysis and Dissemination of Demonstrated Energy Technologies (CADDET) [47],[48].

A year after the farm's completion, the Ministry of Economic Affairs' published its Third Energy Memorandum (1995), which increased the target for wind energy. It did not articulate specific goals for offshore wind energy, which it still referred to as "large-scale and very capital-intensive" [49], but the aforementioned onshore implementation issues had made it was clear that the Memorandum's goal of '45 PJ of primary fuel savings in 2020' could not be realized on land alone, as the maximum attainable onshore potential was thought to be around 1,500 MW [50]. Shortly after the Third Energy Memorandum, the TWIN program was followed by TWIN-2 (1996-2000). Novem, the Ministry of Economic Affairs' environmental agency, ordered a feasibility study into a 100 MW "Near Shore Park" as part of the program. At this point, it considered offshore locations to be the "most favourable in the long run" [51]. The feasibility study was conducted by ECN, Delft University of Technology, manufacturer Stork Energy, offshore company Heerema, engineering agency Fugro, the joint electricity producers organization SEP, and energy company ENW and focussed on current state-of-the-art turbines adapted to marine environments [45],[51]. The study was meant as a first step towards a pilot project which would be aimed at learning lessons for those future wind farms further offshore that were thought to be necessary to reach national targets [52]. The study concluded that a 100 MW farm was technologically feasible and economically viable if supported through investment- and exploitation subsidies [53]. In 1997, the strategy to reach the *Third Energy Memorandum*'s general wind energy targets was laid out in the action programme *Renewable Energy on the March*. It translated the '45 PJ in 2020' target to some 2,750 MW installed capacity [54] and reiterated that this would necessitate substantial offshore wind energy, although it did not expect large-scale construction until "well after 2000". In 1998, environmental effect reports (MER) procedures were started for five possible locations for the demonstration park [55], taking into consideration aspects of safety, shipping lanes, landscape, and technical and economic feasibility [56]. In early 1999, Novem presented an 'offshore wind energy placement plan' which contained the results of a number of the aforementioned feasibility study[1] and proposed to go ahead with the construction of the 100 MW demonstration park, which it thought could be operational in 2003 [55] and instrumental in "clearing the path for the construction of larger wind farms further out at sea" [58]. Later in 1999, the Minister of Economic Affairs announced a location 8-15 km off the coast of Egmond-aan-Zee This was a relatively near shore location within the 12-mile 'territorial waters' zone, which was thought to be a necessary first step for the development of parks further out to sea: experiences with this farm would be used to design effective policy for future parks.

[1] One conclusion was that 3250 km2 of possible offshore wind locations was available in water less than 20 m. deep and factoring in shipping routes, cables, pipelines and offshore resource mining [55], yielding a potential of between 4000 and 6000 MW [57].

[INSERT TABLE 4 ABOUT HERE]

4.3 Urgency and optimism: towards two OWP farms (2000 – 2002)

In late 1999, several private projects developers unexpectedly filed requests for permission to construct and operate offshore wind farms (interviewees 3,4,6,7,9). One of these was E-connection, which had extensive experience in developing onshore wind. One of its multiple applications pertained to a location in 'zone Q7' *outside* the 12-mile zone. It had started developing the plan in 1998 in partnership with a German party that later withdrew (interviewee 6) and after the positive results of the aforementioned feasibility study into the experimental near-shore wind farm and the resulting broader awareness of the potential of offshore energy [48]. The choice was based in part on the low visibility from the shore at that distance, and less expected interference of migrating birds, both of which were though to decrease the chance of opposition by coastal communities (interviewee 3),[59]. The location would also necessitate the unprecedented placing of turbines in water depths > 20 meters. The required environmental impact assessment (MER) procedure was initiated in 2000.

By that time, policy expectations around offshore wind had increased further. In late 2000, a Ministry of Economic Affairs study into long-term visions en energy supply created four possible futures: 'free trade', 'isolation', 'great solidarity' and 'small-scale ecology' [60]. In all four scenarios, wind power would play a role and in three (all except the last) offshore wind was assumed to have broken through [61]. Long-term thinking about energy systems was becoming increasingly popular with policymakers at the time: in its Fourth National Environmental plan ('NMP-4'), the government recognized the persistent nature of environmental problems, as well as the need for radical innovation and structural changes in the energy as well as the policy regime [62]. Such changes would not only require long-term policy commitment, but which could also not be expected to produce beneficial effects in the short run. This new policy paradigm was termed 'transition policy'. The NMP-4 saw a "reasonable perspective" for offshore wind, especially when a "good location policy" were adopted [62: p.168]. One of its six scenarios for a transition to a sustainable energy supply in 2030 included large-scale development of OWP ("100 to 150 farms equal in size to the planned Egmond-aan-Zee project", [62: p.155]). 2001 also saw the liberalization of energy market for bulk users, while small-scale consumers were now allowed to choose their supplier only for 'green' electricity.

In 2001, a parliamentary consent concluded the planological core decision' (PKB) planning process around Egmond-aan-Zee location for the government's experimental park. It had been decided that from that point on, the park would have to be developed further by market parties and so a tender was issued for its construction and operation in 2001. A subsidy of €27 million was made available from the Ministry of Economic Affairs' budget for CO2-reduction, but in return, proposals would have to include an extensive monitoring program of what came to be known as the Offshore Windpark Egmond aan Zee (OWEZ). Several consortia made a bid, and the concession was awarded to NoordzeeWind, a consortium between Shell and Nuon. In late 2001, the other (Q7) farm's MER report conclusions were accepted by the government. E-connection's initiative for the commercial exploitation of a park outside the 12-mile zone which was thought to be technically and economically feasible [58] raised some questions about the initial experimental farm's near-shore location, but the government saw no reason to reconsider Egmond-aan-Zee [56]. The licence for Q7 was granted in early 2002 [63] and later that year the government announced that the two consented offshore wind farms would be eligible for two pre-existing fiscal instruments aimed at stimulating environmentally-friendly investments: the discretionary depreciation mechanism VAMIL and energy investment tax credit EIA [64].

The idea had been that a policy for offshore wind would be drafted based on experiences with the explicitly experimental first farm, but now E-connection had unexpectedly filed (and eventually been granted) an application to construct an additional park at a time when policymakers had not expected interest by the market: the private sector had caught up with the government [65]. No specific legislation for the licencing of offshore wind energy yet existed. In response to this "completely unclear legal situation" (interviewee 6), the government simply "taped the mailbox shut" (interviewee 14). Additional OWP farm location applications by developers Nuon, Evelop, Greenpeace and E-connection (interviewee 6) were then faced with a moratorium on applications for licences in 2001, pending an institutional reform that would empower the broader roll-out of OWP: the design of a system of permits for construction of farms [66],[67],[68]. The applicants formally objected, but also joined forces to regularly talk to the government about what such a system should like, in an attempt to "convert the running lawsuits into something more constructive" (interviewee 6).

[INSERT TABLE 5 ABOUT HERE]

4.4 Licencing troubles and controversies (2003 – 2006)

The new licencing policy that the government had announced at the time of the 2001 moratorium was proposed to a concession system (after the Danish example), whereby strategic zones would be designated by the government, within which interested parties could request a concession which would be a requirement for a licence to construct under the Wbr (i.e. somewhat similar to the OWEZ farm's process). Smaller developers argued against such a concession system, believing that it favoured 'big players' over newcomers (interviewee 6,9) and favouring handing our licenses under current legislation (i.e. similar to the Q7 farm's process). For example, project developer Evelop argued that under the government's proposed concession system, "[y]ou'll only get a licence if you can demonstrate with certainly that you can build the park. This drives independent developers out of the market. Only big players like Shell and Nuon can give such guarantees" [69]. However, the promised concession system took longer to materialize than the would-be developers desired. Greenpeace attributed this to the fact that the process involved multiple ministries (notably the Ministry of Economic Affairs, which was responsible for energy policy, and the Ministry of Transport, Public Works and Water Management which was responsible for activities in the Dutch EEZ's seabed), and to a general a low "sense of urgency" around climate change by the government [67],[70]. Indeed, the center-right coalition (CDA/VVD/LPF) which had come to power in mid-2002 had cut down severely on renewable energy subsidies [71] and this impacted the future of offshore wind as well: whereas the previous Minister of Economic Affairs had called the realization of a "generation capacity of 6000 MW at sea" by "2020 at the latest" both "possible" and "necessary for urgent reasons of great public gravity" [72], the new one was less optimistic and commissioned a societal cost-benefit analysis of offshore wind by the Central Planning Agency (CPB). In the subsequent center-right coalition (CDA/VVD/D66) that came to power in 2003, renewable energy wasn't a key issue, either: the Minister of VROM delegated the topic of climate policy to her Secretary of State who did not succeed it making it a priority [71] while the Ministry of Economic Affairs's energy policy efforts were primarily focused on the full liberalization of the energy market in 2004, and on redesigning the failed sustainable energy demand subsidy (REB) scheme (which had resulted in large sums of tax income leaking to foreign nations) into a new open-ended production subsidy [71]. This Electricity Production Environmental Quality scheme (MEP) came into effect in 2004 and granted, for a period of 10 years, a guaranteed subsidy per kWh to producers of renewable energy (interviewee 6). It was crucial for the OWEZ and Q7 farms: subsidizing the 'uneconomic premium' on the production of renewable energy would make the offshore wind parks owners' income a combination of this kWh subsidy (MEP) and the electricity sold under a power purchase agreement (PPA). MEP subsidy was applied for by and - eventually - granted to both parks.

While the government was working towards designing a concession system, market parties and research institutes were working towards generating the required expertise and knowledge for reaching the 6,000 MW in 2020 target. To this end, some 30 parties from the energy sector (e.g. Nuon, Eneco, Delta, Tennet), the offshore industry (e.g. Ballast Nedam, Fugro), wind farm developers (e.g. Shell, Siemens) research institutes (e.g ECN, TU Delft), and NGO's (e.g. including Greenpeace, Stichting De Noordzee), had formed a consortium called 'We@Sea' around 2003 [73] and in 2004 received funding for a research project aimed at applying experiences with the OWEZ wind farm to future ones (interviewee 6).

At that point, the government presented a proposal for concession system for these future parks but it was overruled by the Council of State, in part on the grounds that it felt that the argumentation for the chosen zones was insufficient (interviewee 6,9). Small independent developers, who had been against the concession system in the first place, as well as Greenpeace argued that it would be a mistake to go back to the drawing board: the continued absence of a licence policy was scaring off potential developers and investors (e.g. Evelop acquired a licence for an OWP farm in the UK [69]). They argued it would result in a stagnation of offshore wind deployment after the commissioning of the two consented parks [67],[70],[74]. Several members of parliaments argued for moving quickly so as not to completely lose momentum and give market parties the chance to apply for licenses based on *current* policy instead [75]. For example, Samsom (Labour, opposition) called on the Minister to "(…) forget about the concession system, [because] on the basis of current legislation it is already possible to hand out licences with which investors and developers can get to work immediately" [76]. In mid-2004, Minister of Economic Affairs Brinkhorst (D66) announced to be open to this option [75], even though Liberal (VVD) and Christian Democrat (CDA) members of parliament were already arguing for pulling the plug on the '6,000 MW in 2020' goal, reasoning that offshore wind was too expensive an option for realizing its European renewable energy target [74], Brinkhorst took a middle road: he claimed to favour offshore wind energy deployment proceeding in a phased, financially controlled fashion that left the possibility of *not* realizing the 6GW goal: "should the necessary cost reduction not materialize, we can shut off the money stream on time" [77].

Feeling that market parties would be willing to compete with one another for prime locations [65] and knowing that it was not allowed to string along would-be developers much longer (interviewee 6), the government lifted the moratorium in late 2004 and announced that licencing would take place on a first come first served (FCFS) basis: whichever party managed to complete an application (which needed to include an environmental effect report) for a given location the first, would get the licence. Subsequently, the Ministry of Economic Affairs made

available the aforementioned open-ended production subsidy (MEP). Interest was far greater than expected, however: already in the first months of 2005, some 60-70 applications were filed, many for overlapping (i.e. the cheapest) locations. The process was heavily criticized, and has been characterized by many involved parties as highly inefficient, due to e.g. wasted research resources on overlapping environmental effect scans for applications which were not granted (interviewee 4,6,7). The Department of Public Works (Rijkswaterstaat), the Ministry of V&W's executive agency responsible for managing the Dutch sea bed and consequently the licencing procedure, became overloaded (interviewee 7). As a result, the government temporarily closed the licence application process already in mid-2005 [78] and also cancelled the MEP production subsidy scheme for offshore wind and biomass, stating as a reason that costs would run out of control due to the unexpectedly high number of applications: it was too successful and therefore too expensive [79]. Later that year, the results of the societal cost-benefit analysis of offshore wind by the Central Planning Agency (CPB) which the previous Minister of Economic Affairs had ordered in 2002 were published. It concluded that investing in offshore wind in the short term would not be 'societally profitable'. In response, the Minister of Economic Affairs stated that the report confirmed his choice of his temporary freezing subsidies as well as his phased deployment strategy, but political parties VVD (liberals) and CDA (Christian Democrats) called for a definitive end to the subsidization of offshore wind [80],[81]. The CBP report's conclusion were called into question by offshore wind proponents, however, who argued that its outcomes were heavily dependent on questionable assumptions about e.g. learning effects, future oil prices and CO_2-emission prices [82].

Contestation also haunted the licensing system. The Dutch Wind Energy Association NWEA, a branch organization composed of wind sector actors to lobby for their interests, still favoured a first come first served licencing (FCFS) process at least for the subsequent 'Round 2' of licencing (interviewee 6). Others argued that the FCFS process was only suitable for more mature and stable industries [83],[84] and called for the licencing system to be redesigned immediately. For example, environmental organizations argued that "(…) offshore wind is no business for the free market. Wind farms require financial support and careful special planning. This is a government's task: it should stimulate offshore wind in a predictable fashion and take charge of the locations of wind farms" [85: p.6]. When the moratorium was lifted again in early 2006, the licencing process was still first-come-first-served. The Minister of Economic Affairs did however promise to redesign both the licencing- and subsidy procedures in dialogue with the offshore wind sector [78]. But instead, in mid-2006, the Minister of Economic Affairs unexpectedly and unilaterally terminated the subsidy scheme altogether, arguing that The Netherlands were on course for realizing the '9% renewables in 2010' goal and so no further subsidy was needed. The government admitted that the subsidy scheme's design had been flawed: projects meeting

the criteria could not be refused and were awarded a guaranteed production subsidy based on a price expectation, but because price levels fluctuated, costs increased dramatically and the budget was exceeded [71]. In its stead, the government now desired a new and less out-of-control subsidy scheme based on tenders and budgets per sector ([86], interviewee 4). The NWEA called the government "unreliable" in response, blamed the Minister for not having consulted with the sector as promised [87], and started lobbying for a redesigned MEP based on a feed-in tariff [88]. Around the same time, the OWEZ farm began supplying electricity to the grid. Plagued by licencing issues, construction had only begun in late 2005. The farm had been built by the Egmond Building Corporation: a joint venture between turbine manufacturer Vestas and contractor Ballast Nedam that had previously constructed the *Lely* farm (interviewee 3). On the occasion of its opening, We@Sea proclaimed this "first North Sea wind park" to be "more important than the first man on the moon" [89].

[INSERT TABLE 6 ABOUT HERE]

4.5 Towards a second round of rollout (2007 – 2009)

After parliamentary elections in late 2006, a center-left coalition (CDA, CU, PvdA) came to power in early 2007. Although sustainability had not played a major role in the election campaigns, the theme received an unexpectedly prominent place in the coalition agreement, which some attributed to the peaking public attention to climate change [71],[90]. It articulated highly ambitious goals for 2020 (30% CO2 reduction, 20% energy savings in 2020, 20% renewable energy), although it did not go into the specifics of how these should be achieved. NWEA reacted enthusiastically to the coalition agreement and lobbied for offshore wind as a way to realize the agreement's ambitious goals. It called for swift decisions on Round 2 of OWP deployment, as well as a more strategic location study for a future Round 3, because considering other North Sea stakeholders in such a process was argued to speed up deployment [91]. NWEA was also consulted by the Ministry of Economic Affairs about design of the production subsidy successor to the failed MEP scheme [92],[93],[94]. In late 2007, the government published its strategy for realizing its coalition agreement. It announced a new, capped, production subsidy system (SDE), which, it promised, would be used also to stimulate offshore wind deployment. It committed to 450 MW of offshore capacity in Round 2, to be allocated through an SDE tender among parties that would have acquired a license, as well as a solution to the issues around the licencing system for Round 3, by the end of its period in office in 2011.

In 2007, several such licence applications were denied by Rijkswaterstaat (RWS) [95], leading Lower House member Samsom (PvdA) to ask questions in parliament about a supposed categorical denial of applications, but the Ministers of V&W and Economic Affairs denied the allegation and argued that the new criteria were based on progressive insights about shipping safety stemming from the shipping sector's experience with the two Round 1 wind farms [96]. In part to prevent such future conflicts of interest with the nautical sector, NWEA continued to lobby for a strategic and collective location policy involving all potential stakeholders, using the British system as an example, for the future Round 3, while still favouring the current system for the upcoming Round 2 [97].

And indeed, in April 2008 the government announced that as a part of a new National Water Plan it would allocate offshore wind energy areas where the remainder of the '6000 MW in 2020' goal could be realized. This was meant to give a "steering role to the [next] cabinets that need to realize the 2020 target" [98]. In its mid-2008 Energy Report the Ministry of Economic Affairs reiterated its promise to provide a clear vision on the future uses of the North Sea and a coordinated approach to spatial planning, licenses and stimulation through SDE. It also reiterated the long-term '6000 MW in 2020' goal and explicitly framed the North Sea as an energy source [99]. A late-2008 draft version of the National Water Plan appointed two large areas for Round 3 of Dutch development which would take place between 2015 and 2020: IJmuiden-Ver (a ~1170 km2 area where it was thought some 5000 MW could be realized) and Borssele (344 km2, 1000 MW), as well as 'search areas' for further Round 3 development.

Around that time, the second and final Round 1 OWP farm began supplying electricity to the grid, on which occasion it was officially renamed 'Princess Amalia'. Its construction had been delayed by E-connection's initial trouble finding investors, but after it had transferred its rights to construct and exploit the Q7 farm to investors energy company Eneco and renewable energy company Econcern in mid-2006 and reached financial close in late 2006, construction had commenced in the hands of Danish companies Vestas (turbine supply) and A2SEA (turbine installation), and Dutch companies Smulders (monopile construction) and marine contractor Van Oord (foundation installation and cable laying) ([59], interviewee 1).

In early 2009, the to-be-subsidized (through SDE) capacity for Round 2 was increased from 450 MW to 950 MW as part of an economic stimulus package ('groene stimuleringspakket') to combat the economic crisis ([100]; interviewee 4). The total amount made available for the 950 MW tender was €4.5 billion, to be paid as a production subsidy over a period of 15 years. This number was based on an ECN estimate of 16-19 cents/kWh by ECN [101]. An SDE subsidy tender was opened to realize this 950 MW capacity: parties that at the time of the tender would

have acquired a licence for an OWP farm could compete on kWh price (with a correction factor for distance to the shore).

A few months later, Minister of Economic Affairs Van der Hoeven wrote a remarkable opinion piece in national newspaper *de Volkskrant,* which seemed to contradict her recent policy choices by stating that "for the next few years, renewable energy is a too limited and too expensive option for CO_2-reduction" and that CO_2 mitigation "shouldn't come first in renewable energy policy". Believing that the economic crisis necessitated an "economic approach to renewable energy", she argued for an end to the indefinite subsidizing of the market price / cost price difference which "makes companies lazy". Instead, she argued for a focus on European (versus national) targets to stop the "subsidy war between member states" whereby multinationals build wind farms wherever subsidy is the highest. She also argued for creating "green jobs" and stimulating innovation in those sectors where The Netherlands could have a competitive advantage, such as offshore wind where, she argued, subsidies would likely be inevitable for a while but should end by the end of the next Cabinet's period in office [102]. A month later, the Minister established a 'Taskforce Offshore Wind Energy' to advise on the optimal way of involving the private sector in achieving the policy goal of 6000 MW in 2020 [103]. In response, a new consortium of 10 actors from industry and reseach (RWE, Eneco, TenneT, Ballast Nedam, Van Oord, IHC Merwede, 2-B Energy, XEMC Darwind, ECN and TU Delft), many of whom had partaken in the We@Sea consortium, presented a joint initiative called Far and Large Offshore Wind (FLOW) which was aimed at R&D into innovative turbines, foundations, and installation- and maintenance methods aimed at future wind farms farther out in the North Sea ([104], interviewee 6).

In September 2009, the Ministers of Economic Affairs, V&W and VROM, jointly published their 'National Water Plan' (NWP) 2009-2015, which laid out the key points of the nation's water policy. They also announced that for the future Round 3 they had opted for a concession system: within the aforementioned wind energy areas, large enough in principle to accommodate 6000 MW, it could give exclusive permission to market parties to develop OWP parks and within which it could deny non-OWP projects. It could also deny applications to construct OWP parks outside these areas, which was meant to prevent conflicts with other North Sea users. Moreover, in the new concession system, spatial planning would be coupled to financing unlike in Round 2, where one first had to acquire spatial planning license and could then compete for SDE subsidy [105].

Meanwhile, the parties who would compete in this Round 2 SDE tender were coming into focus. Of the dozens of licence applications submitted by that time, twelve had been granted by the Ministry of V&W: the rest had been rejected mostly due to proximity to shipping lanes, drilling

platforms, helicopter routes, offshore sand mining, and bird colonies [106]. The majority of the participants in the tender were foreign parties, notably German (4 parks RWE and Bard Gruppe), and Irish (3 parks, Airtricity) (Irish), RWE (German). In early 2010, the winners were announced to be two subsidiaries of German wind farm developer Bard Gruppe, who had proposed three (and had been granted subsidy for two) adjacent 300 MW parks north of the isle of Schiermonnikoog. They had beaten some of the large names (e.g. Eneco, Nuon/Vattenfall, Essent/RWE) on the key criterion of price: because Bard Gruppe already had a German OWP farm close to the proposed location, estimated maintenance costs were relatively low [107] (In 2011, Dutch project developer Typhoon would acquired the licence and SDE commitment from the financially struggling Bard Gruppe). It was now clear that the allocated budget would be insufficient to realize the desired 950 MW [108]. The remaining budget of approx. €1 billion would be allocated in late 2011 to a different, smaller (129 MW) configuration of Eneco's application in the Q10 plot (interviewee 4,7) which was renamed 'Luchterduinen'.

But around the time of the announcement of the SDE winners, the center-left cabinet fell: it was succeeded in late 2010 by a more conservative, center-right minority coalition between the economic liberal parties VVD and CDA. New Prime Minister Rutte (VVD) had set the tone for his party's take on wind energy during the elections by famously stating that "windmills don't 'run on wind, but on subsidies". Soon after his appointment, the new Minister of ELI (Verhagen) drastically altered the SDE production subsidy scheme. In the resulting SDE+ scheme, instead of differentiated cost-of-production estimates for different renewable sources, a single amount was set for all renewables. Additionally, subsidies for offshore wind (along with small-scale solar PV) were terminated altogether. Verhagen stated that "[w]here the previous SDE focused on two goals, roll-out and innovation, I want to focus SDE+ on an efficient roll-out to make headway in achieving the target of 14% renewable electricity in 2020" [109]. Offshore wind had no place in this, as it was too expensive to compete (interviewee 4, 6): "SDE+ is not a beneficial system for offshore wind, which is outcompeted by cheaper alternatives" (interviewee 4).

[INSERT TABLE 7 ABOUT HERE]

4.6 Offshore wind as a top sector (2010 – 2013)

The way of thinking articulated in Van der Hoeven's 2009 opinion piece, in which sustainable energy would have to fit with existing economic criteria, would come to exemplify the new cabinet's policy. Sustainability was considered subordinate to economic policy, and would have to be realized through innovation, not (or at least to a lesser extent) through subsidy. As a focus

area, ‘innovation’ now fell under the Ministry of Economic Affairs even in name: it had merged into the Ministry of Economic Affairs, Agriculture and Innovation. The ‘transition policy’ paradigm of the early 2000s now gave way to the concept of a ‘top sector policy’ [71], in which the government aimed to stimulate cooperation between industry, research and policy for nine innovative sectors in which The Netherlands excelled internationally. The initiative would lie primarily with market parties: the government would adopt a more facilitating role than it had before.

Consistent with this new paradigm, the government made dozens of ‘green deals’ (mostly relating to energy) with private sector and societal organizations with the aim of “making sustainability more economic” [110]. Specifically not a subsidy instrument, the green deals were aimed at bringing parties together, providing knowledge, and “removing policy barriers”. The initiative would lie with private sector parties, who were required to show that their initiative would result in new economic activity and/or cost reductions. One such initiative was the ‘Green Deal Offshore Wind’, which was made in late 2011 between the government and wind sector representative NWEA (interviewee 6). Its main goal was a 40% reduction in the cost of offshore wind by 2020 – a cost reduction was which now seen as a precondition for the large-scale roll-out of offshore wind. The press announcement focused strongly on the Dutch offshore wind sectors job potential (from a current total 2,200 to 11,000 in 2020 if a home market could be developed), the “exceptionally favourable conditions of the Dutch part of the North Sea”, and the sector’s previous involvement in the construction of (all) North Sea OWP parks. Some 50 parties (including FLOW) signed up, and the green deal was symbolically announced as “the birth of the Dutch offshore wind sector” at the European Wind Energy Association (EWEA)’s OFFSHORE 2011 trade show in Amsterdam (interviewee 6).

One of the sectors in the new government’s top sector policy was energy, and offshore wind was designated as one of seven key areas in this sector. A key role in the new top sector policy would be for so-called Top Consortia for Knowledge and Innovation (TKI’s): partnerships between market parties and knowledge institutes for research that should lead to economically viable solutions to societal problems. The industry and research-led FLOW initiative fit perfectly in the new policy paradigm [111] and in early 2012, it accepted the government’s invitation to act as TKI for offshore wind and issued a tender for projects (interviewee 6).

In addition to the green deals, so-called ‘innovation contracts’ were drafted for each the top sectors as part of the top sector policy (interviewee 6). These innovation contracts contained measures, plans and agreements to strengthen the sectors in the near future. An Offshore Wind Innovation Contract was signed in early 2012. It aimed at a 6 billion EUR offshore wind sector revenue in 2020, and argued that this could only be achieved through innovation aimed at cost

reduction, application of such innovations in a demonstration park, and a subsequent roll-out [112], which was envisioned to take place from 2016/2017 onward and achieve over 5000 MW in 2020. The contract further stated that a perspective on a home market would be essential for industry commitment, and that "the question was not if offshore wind would take off, but if The Netherlands can maintain its leading position". In late 2012, the OWEZ monitoring program's results were presented at an Offshore Wind and Ecology Congress: it concluded that the park had had next to no adverse consequences for birds, fish and other marine life, and in fact had significant positive effects, such as on cod and harbour porpoises which are drawn to the abundance of sustenance in the wind park (where fishing is not allowed).

Rutte's cabinet fell in April 2012, and the September 2012 parliamentary elections were won by conservative liberal VVD and labour PvdA. NWEA lobbied for offshore wind during the parties' coalition agreement negotiations [113]. The resulting coalition agreement referred to OWP as a "promising sector" and pledged to support energy sector- and OWP industry initiatives to stimulate innovation to "bring down the cost price of OWP at an increased rate". Simultaneously, it increased the 2020 sustainable energy target from 14% to 16% (VVD and PvdA, 2013). Many felt that this target could not be realized without OWP and by mid-2013, the new (VVD) Minister of Economic Affairs agreed: he referred to OWP as indispensable for realizing 16% renewables in 2020 and announced his willingness to earmark part of the SDE+ budget specifically for OWP. Although he referred his own suggestion as "unelegant" and " not in the spirit of the SDE system" which has been designed to favour the least expensive renewable energy options, he argued that the "low-hanging fruit" options would eventually deplete the budget but not realize the target, leaving nothing for OWP at the point when it would be ready (i.e. cheap enough) to make its contribution to the target [12]: "if we want to realize 16%, then the more expensive options have to be on the table again, as well" (interviewee 6). In addition to the search for additional wind energy areas promised in the 2009 National Water Plan (and which had focused on two large areas of west of the Province of Noord-Holland and north of the Wadden islands) that would result in a new 2014 offshore wind strategic structure agenda ('structuurvisie wind op zee'), the government now also ordered a feasibility study for OWP construction *within* the 12-mile zone, arguing that it wanted to explore all options to meet the '16% in 2020 target' and reasoning that OWP is cheaper when constructed nearer to the shore. According to some, this study is mostly a "trial balloon aimed at seeing how coastal municipalities and citizens react" (interviewee 7). A major 2013 national energy agreement set the 2020 target back to 14% again, but it did add a specific offshore wind goal of 4450 MW in 2023 [114].

[INSERT TABLE 8 ABOUT HERE]

5. Conclusions & discussion

This paper has made two main contributions: (1) bringing together and adding to the fragmented academic literature on offshore wind policy in The Netherlands by providing a comprehensive chronological review of four decades of Dutch offshore wind developments in six periods of relative stability, and (2) analyzing the effects of various policies in these periods on the shielding, nurturing and empowering of offshore wind in these periods.

Regarding the first main contribution, the six periods are:

1. The first period (1973-1985) is characterized by the emergence of the idea of OWP among engineering- and policy communities. OWP began as a possible diversification option as a response to the 1972 oil crisis. Given the dominance of 'large scale thinking' about energy systems, offshore placement was considered and researched, but dismissed as being prohibitively expensive compared to onshore wind in the foreseeable future. Nevertheless, minor policy support took the form of small parts of consecutive renewable energy research funding programs' budgets (to research into offshore wind energy as a long-term option).
2. The second period (1986-1999) is characterized by policymakers increasingly coming to see the offshore siting of wind turbines as a possible solution for the problematic realization of their onshore wind targets due to societal opposition. Funds were made available, which resulted in a small offshore wind experiment by an energy company, and a study into a larger farm was commissioned, which resulted in the policy decision to construct (and partially fund) an experimental 100 MW farm in the North Sea.
3. The third period (2000-2002) is characterized by the emergence of the 'transition policy' paradigm in general, and a further increase in policymakers' expectations around offshore wind in particular. This resulted in the ambitious policy goal of 6,000 MW in 2020 and by the search for a market party to construct the first large Dutch experimental offshore wind park. It is further characterized by the private sector taking an unexpected interest in offshore wind energy at a time when no policy was yet present, which resulted in an ad-hoc 'solution' in the form of moratorium on license applications.
4. The fourth period (2003-2006) is characterized by contestation in a context of consecutive governments for whom climate change and renewable energy were not priorities: contestation around the various licenses required for the two consented OWP farms; contestation over the optimal licensing procedure for future ones; and finally, contestation over the legitimacy of government subsidization of what in this period is increasingly

framed as a too expensive option for realizing the Dutch renewable energy targets. One characteristic result of these contestations in this period is increased collaboration among actors in the Dutch offshore wind energy sector. Towards the end of the period, the 2001 moratorium is briefly lifted but quickly reinstated, and it concludes with the withdrawal of subsidy for OWP.

5. The fifth period (2007-2009) is characterized by a renewed impulse for OWP. In the context of increased societal attention to climate change, a new (center-left) cabinet sees OWP as a climate change solution. The moratorium is lifted once again, and while the government evaluates applications, it announces a subsidy tender for what is now referred to as 'Round 2' of OWP deployment and promises a concession system for the future 'Round 3'. But after the two 'Round 1' farms come online, the subsidy is granted, and the concession system laid down in a new national water policy, the cabinet is replaced by a more center-right one which substantially revises renewable energy subsidy system and eliminates OWP from it.
6. The sixth period (2010-2013) is characterized by a shift in policy support for OWP from deployment to cost-reduction through innovation in the context of the new cabinet's 'top sector' policy paradigm: stimulating industry-research-policy cooperation by adopting a facilitating role in supporting initiatives by market parties. OWP is named a 'key area' in the 'top sector energy' in part because of its job potential and is supported through a 'green deal' and an 'innovation contract'. The OWP sector's focus is now significant cost reduction, which was made a prerequisite for (financial) government support for further deployment in a future 'Round 3'.

We acknowledge that this periodization is a descriptive abstraction that we superimpose on historical events [115]. Nevertheless, we argue that the periodization we constructed helps to signify and understand the role of policy in Dutch offshore wind development, because the periods represent blocks of time within which certain characteristics of Dutch offshore wind development were relatively stable: either specific contextual developments (such as changing political landscapes and the shifting prominence of climate change), or offshore wind-related developments (such as changing expectations regarding OWP and changing OWP policies), or actor configurations (such as the types of actors interested in OWP). Additionally, while the fact that our periods become shorter over time may seem to suggest 'temporal discounting' or 'present bias', we argue that this is rather the result of offshore wind developments having objectively intensified over the period under study (e.g. increasing media coverage, increasing numbers of actors involved, increasing parliamentary debates on OWP, increasing global deployment etc.).

As to the second main contribution, we specifically investigated the relation between policy and the shielding, nurturing and empowering of offshore wind in these periods. The following four conclusions therefor provide an answer to our research question about how policy has enabled and constrained the development of offshore wind in The Netherlands.

1. Previous studies using the S/N/E framework have analyzed the three processes from the perspective of innovation advocates. In practice, this has meant examining the work done by these actors to (attempt to) shield, nurture and empower their innovation of choice. We found that in relation to policy, such work by innovation champions prominently includes lobbying activities (e.g. the way in which the IRO report translated to a small budget within the NOW program, and the inclusion of OWP in the top sector energy). This provides an important barrier for case studies such as ours, as much of this work occurs 'behind closed doors'
2. We expected to find policies that were not specifically designed for shielding or nurturing OWP but that were strategically mobilized for these purposes by advocates, as was the case in the development of solar PV [23],[26]. Surprisingly, we found no significant evidence of 'generic' extant policy being mobilized in this way. We did however find instances of policies that were *intended to enable* OWP (e.g. MEP, or the first-come-first-served licensing procedure) but that backfired due to design flaws and unforeseen interest (and that were therefore quickly withdrawn). This resulted in an inconsistent support trajectory that several interviewees have characterized as having done more harm to the development of OWP than the absence of support mechanisms would have. In other instances, new (or redesigned) policy specifically *intended to constrain* OWP rollout: this typically occurred when new, more conservative, cabinets came in power who favored realizing emissions targets in the cheapest possible way. It is known that in the case of solar PV, proponents develop their technology further in different (building-integrated, decentralized, off-grid) application domains in absence of dedicated policy support [23],[26]. But OWP's capital-intensive socio-technical configuration largely precluded this option. One possible exception is the recent move by the Dutch OWP sector towards focusing on supportive innovations for future deepwater OWP farms, which could be framed as a move to a new space in the absence of support for deployment.
3. We found a general discrepancy between the goals and effects of policy, which is most clear in empowering processes. For example, we interpret the emergence of consecutive environmental policy programs (NMP 1 through 4) as the institutionalization of sustainable values and, as such, attempts at empowering of alternative energy options in general. Nevertheless, insofar as this had any significant empowering effects for sustainable energy at all, they certainly had none specifically for OWP. Only with the arrival of the MEP

production subsidy that aimed to level the playing field did signs of empowering *effects* (in addition to intentions) on OWP emerge. Yet these failed to result in a break-through of OWP as the policy was frequently altered and eventually withdrawn, to be replaced recently with a more fit-and-conform empowering policy aimed at rendering OWP competitive under mainstream conditions (i.e. stimulating innovation aimed at cost reduction before supporting roll-out).

4. We found that policies have had constraining and enabling effects on multiple (shielding, nurturing, empowering) processes at once: in several instances, we see that one and the same policy has shielding effects (e.g. NOW-1 and NOW-2 providing funds for exploring the idea of offshore wind, or TWIN providing funds that are used for the *Lely* experiment) as well as nurturing effects (e.g. NOW-1 and NOW-2 coalescing a network of researchers, or TWIN articulating goals for OWP). Shielding, nurturing and empowering are therefor not necessarily consecutive processes (i.e. first creating a space, then filling it with experiments, which then 'break through'), as was previously implied by Smith and Raven [25].

Although the framework has proved generally useful for the purpose of analyzing the role that policy has played in shielding, nurturing and empowering Dutch offshore wind over the past four decades, we acknowledge that it cannot claim to fully explain this policy's 'erratic' course itself – a characterization that is often invoked as an explanation for the relatively poor Dutch performance in terms of renewable energy (e.g. interviewee 3,4,6,9). Although our account empirically illustrates the impacts of this erratic policy course on a specific innovation, landscape-level policy shifts (such as the privatization and liberalization of the energy market, or the replacement of a transition-oriented policy to a top sector policy) currently remain exogenous to our account. Internalizing these thus becomes an important challenge for future research.

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